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ABSTRACT

Findings are summaried related to restricting minority participation in the sciences and science-related professions. Four factors found most pervasive and important were: (1) lack of role models; (2) counseling; (3) attitude; and (4) preparation. Effects of both teacher attitude and student attitude were reviewed within the attitude area. The paper also reviews several promising practices currently being implemented to upgrade minority participation, including the roles of industry and institutions of higher education as well as collaborative efforts. (Author/DS)

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SCIENCE EDUCATION FOR THE EIGHTIES: MINORITY PARTICIPATION*

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During my presentation this morning I will touch upon those areas that seem to be most important vis-a-vis the participation of minorities in science courses at the secondary and post-secondary levels, and subsequently in the science-related professions. Throughout my presentation, references to minorities not being proportionately represented, in the sciences will relate primarily to Blacks, Hispanics and Native Americans.

Interest in the planful upgrading of minority participation in the sciences was given impetus by the civil rights movement of the 1960's, that directed attention toward the equal treatment of minorities in public school curriculum/opportunities. Despite this attention, recent studies related to minority involvement in science courses at the college level have found several factors that restrict minority participation in college science courses. The four factors that seem most pervasive and important are (1) lack of role models, (2) counseling, (3) attitude, and (4) preparation. Toward the end of the presentation I will also refer to some bright new examples of projects that are having positive impact.

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Role Models

In most public school curriculum prior to the civil rights activities that began in the 1960's, there was little emphasis on minority contributions in the sciences. A recent study of the contributions of Black scientists that were included in the curriculum of a set of selected high school classrooms produced some interesting results. It was found that; (1) only 13% of the 353 respondents had minority training of any kind, and only 3.7% of those who had training had studied the contributions of Black scientists, and (2) of the responding teachers asked how often they taught the contributions of Black scientists 2.5% said "always", 5.6% said "often", 11.8% said "occasionally", 20.6% said "seldom", and 58.2% said "never" (Fuller & James, 1980). As the sample above was drawn from areas with high concentrations of Black students, the findings are particularly important to science educators. Suggestions for more attention to enrich the high school science curriculum with the contributions of Black scientists and career opportunities for minority students were made by Dillon and James (1977). When minority group scientists were included as speakers and presentors for high school students there appeared to be positive results (Wainio, 1976).

Counseling

High school counselors often neglect to counsel minority students into the four years of math needed to survive a rigorous science program. Even in desegregated schools counselors often "track" minority students in such a way that they do not get the mathematics needed to be successful in sciences (Green, Parsons & Thomas, 1981) (Rowe, 1977) (McDermott, Piternick & Rosenquist, 1980). A second factor that mitigates against minority students taking science/math courses is that without parental encouragement often students will not sign up for the "hard" courses. At the ninth grade level (or in junior high) a student usually makes out his/her program in consultation with his/her parents and counselor. At this stage it is too early for a student to realize the need to take math/science courses therefore the student does not elect to take them. Without a definite career goal the student usually elects to enroll in courses that demand less work to earn a high school degree. Also, a certain degree of racism still exists among counselors and teachers and they are less inclined to encourage minority students to take the more challenging academic programs (Ignatz, 1975).

Attitude

There is a saying that "Attitude, as much as aptitude, determines altitude." Much of the literature relating to

minority participation in science would agree. The two variables seen as most important are expectation and persistence.

The publication of Pygmalion in the Classroom (Rosenthal & Jacobson, 1968) brought attention and interest to the ways that teachers interact with their low-achieving and high-achieving students. Rosenthal and Jacobson claimed that by creating higher teacher expectations for students, it was possible to improve student performance (vis-a-vis "My Fair Lady"). In his review of teacher expectation/student perceptions Thomas Good found twelve behaviors that teachers varied between students they perceived as high or low achievers (Good, 1981). Mary Budd Rowe (1977) found some interesting results that indicated lowered teacher expectations for some minorities in areas related to academic competence.

Student expectations as related to self-perception and attribution (sense of effacacy) seem to determine the amount of effort students commit to a task (Dillon & James, 1977) (Covington, 1976). Somewhat tied to expectations, was student confidence in their own ability to solve problems, and their personal standards for academic achievement. Recent research (McDermott, Piternick & Rosenquist, 1980) indicates that often minority students have lower confidence and standards than non-minority students entering the sciences.

While no causal relationships have been established between attitudes toward a specific subject area, self-concept, and achievement, correlations between these constructs have been displayed (Alvord, 1971). In a study of the impact of high school science courses on the attitudes of black students, (Dillon & James, 1977), determined that "high school science courses could be of immense value in influencing Black students' attitudes toward science."

When the Beginning Teacher Evaluation Study (BTES) was completed, a publication of the findings (Denham & Lieberman, 1980), determined that "time-on-task" and persistence were directly related to student success (achievement). Minority students have been found to exhibit less persistence in science-related challenges than non-minority students (Rowe, 1977). The factors that promote student persistence and time-on-task have been presented by Covington (1976), as well as other authors concerned with self-worth in relation to school-related tasks.

Preparation

In order for minority students to participate in the sciences they (and all students for that matter) need adequate preparation. Those factors that appear of greatest priority are:

1) Experiences on which to build the abstractions of science. Several recent studies have stressed the importance of hands-on experiences as the basis for the learning of abstract concepts (McDermott, Piternick & Rosenquist, 1980) (Panel on School Science, 1979) (Rowe, 1977).

2) The development of mathematical and verbal skills were identified by McDermott (1980) and Ignatz (1975) as being a limiting factor for minority participation in the sciences at the college level. Lack of mathematical skills was found to be more of a limitation than lack in science background for success in the sciences.

3) Development of problem-solving strategies, self-confidence and personal academic standards have been shown to be of vital importance to minority participation in the sciences with successful outcomes (Green, Parsons and Thomas, 1981) (Covington, 1976).

On The Brighter Side

There are several developments mitigating toward increased participation (and success) of minorities in science and science education. One of the most influential is the increasing efforts by the private (business) sector in attracting minority participation in science-related careers. An example of private industry/education impact on minorities in science is the Education Task Force (ETF) formed by the Hewlett-Packard Corporation. The purpose of the ETF is to determine ways that Hewlett-Packard and various education agencies can work on projects that will be mutually beneficial. The objectives of the program are:

1) To bring practical and interesting information to students and others (counselors, teachers...) in school communities about science, engineering and mathematics and about the career opportunities open to people at all levels of business.

2) To encourage students to pursue challenging courses of study (including math and science).

3) To establish a generally supportive attitude toward public education within Hewlett-Packard and among other employers (Hewlett-Packard working paper, 1981).

Another program focusing attention and support from the private sector to support minorities toward science-related careers was conceived by the Engineers' Council for Professional Development staff and funded by grants from E.I. duPont de Nemours, Eastman Kodak, IBM, RCA and the Olin Charitable Trust. This program is known as the Minority Introduction To Engineering (MITE) program. The program is available to minority high school students at the end of their junior year, and is a two-week summer program on a college campus. The program allows students to experience college life and attempts to motivate them to set high career goals in science-related professions. A study of the program's effects indicates career goals are being altered and more minority students are taking engineering-oriented coursework during their senior year in high school (O'Bryant, 1980).

Some other programs interested in upgrading the participation of minorities in science-related careers operate primarily with college graduates. One such program is the one at the Fermi National Accelerator Laboratory (Davenport, Malamud, Cole and Carrigan, 1977) (Carrigan,Cole, Davenport and Malamud, 1977).

The impact of institutions of higher education have not been directly very effective toward increasing minority participation in the sciences. One notable exception, however, is the Mathematics

Engineering, Science Achievement (MESA) program. The MESA program has spread from the parent campus (University of California, Berkeley) to 15 other institutions of higher education and involves 85 high schools throughout California. Of MESA's 510 graduates in 1980, over 440 went on to college. Of MESA's 272 graduates in 1979, over 186 are now college sophomores. MESA augments high school classes in mathematics and science primarily. It also provides tutoring for minority students to better prepare themselves for college. Enrollment in MESA this year is 2,200+, including 1,000 each of Black and Hispanic students. Female MESA students outnumber males 52% to 48% (The Monday Paper, 1981).

Indirect impact by institutions of higher education in collaboration with local education agencies often results in programs that have lasting effects, as these programs often involve teachers at the junior and senior high schools. An example of this sort of program is the NSF sponsored project involving Mills College and several northern California junior and senior high schools. In this program specially trained teaching teams composed of professors and classroom teachers provide inservice for other classroom teachers related to adolescent reasoning patterns and the learning/teaching of science. Models such as this provide multiple effects possibilities for staff development (Ponzio, 1980).

Another effective example of collaborative impact is the project developed by the University of California's Lawrence Berkeley Laboratory with the U.S. Department of Energy. A particularly interesting part of this program is that it works with junior high school students in hands-on apprenticeship program.

Legislation

Interest in upgrading science instruction by and for minority population groups has become an object of legislation in Washington D.C. (at least up until recently). Programs to support the training of school teachers in mathematics and science at colleges with large enrollments of low income students are being drafted and approved by legislators. The thrust of the legislation is to encourage persons with expertise in science or mathematics, and who come from minority group backgrounds, to enter teaching as a career (Roark, 1979).

Within the California Legislature there has recently (January, 1981) been introduced legislation that would create a "California Mathematics Project" along the lines of the "Bay Area Writing Project" whereby a cadre of skilled mathematics teachers would provide staff development for other math teachers. This project is a multiple-effects sort of program where teachers teach other teachers their best strategies for developing math competence and skill in learners (Assembly Bill #315, 1981).

Summary

Few people doubt that science and technology touch most aspects of personal, national and international life, and that most problem areas — economics, energy, food supply, natural resources, government, land use, health — require scientific input if solutions are to be reached. Scientific literacy is a universal need. If minorities are to participate in the sciences there needs to be a concerted effort to improve skills, attitudes, aspirations and role models of minorities within the sciences.

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